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Mutual Benefit

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'Mutual Benefit' – Investigating how DEC delivery in schools can be supported by industry and higher/further education partners

Preprint · August 2018

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Mutual Benefit:

Investigating how DEC delivery in schools can be supported by industry and higher/further education partners

**design...
engineer...
construct!®**

Lead Author
Alex MacLaren
Associate Professor
Centre of Excellence in Sustainable Building Design
Heriot Watt University

issued:
Summer 2018

Part Funded by



Academic Years 2016-17 and 2017-2018

This document reports on delivering DEC Level 1 in academic year 2016-17, and devising and monitoring delivery of DEC Level 2 in academic year 2017-18. The purpose of the research was to reflect on current guidance, the experience of delivery, to identify areas of particular value and to provide further guidance for others to improve delivery.



Date: July 2018



for Mutual Benefit

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Background

Design Engineer Construct (DEC) is an accredited learning programme for secondary-school age students and has been expertly developed to create and inspire the next generation of Built Environment professionals. Alison Watson, a former Land Surveyor, established social business Class Of Your Own (COYO) in 2009: she created the accredited programme DEC in 2012. Since then, ever-increasing numbers of schools across the UK have begun to offer DEC learning programmes.

In autumn 2017, the authors were commissioned by 'BIM 4 Education' to conduct a short piece of research, retrospectively reporting and analysing their experience of delivering DEC Level 1 in academic year 2016-17, and devising and monitoring delivery of DEC Level 2 in academic year 2017-18. The purpose of the research was to reflect on current guidance, the experience of delivery, to explore opportunities for engagement of higher/further education providers and industry with the DEC scheme, to identify areas of particular value and to provide further guidance for others to improve delivery.

Intended Readership

This report should be of value to all of those engaged in improving STEM education at secondary-school level, and in developing the 'pipeline' of skills for the Construction Industry. The content is arranged to provide a practical resource and effective guidance, and will be of particular interest for those working with the DEC curriculum, including teachers and headteachers; career advisors; parents; industry partners; and higher- and further- education providers.

This report highlights **the value of engaging industry and academia in school-level curriculum**. There is evidential, replicable, **measurable value to all parties**, indicating a **sustainable relationship** that will support **ongoing collaboration at no additional cost**.

Foreword

"This report covers the experience of a secondary school, university and leading contractor in collaborating on the **Design-Engineer-Construct (DEC)** curriculum over the course of a year.

I was fortunate enough to learn from this work as it developed and to witness the enthusiasm and **growing confidence** of young people from Drummond Community High School, and their performance in a variety of tasks. The application of **core Curriculum for Excellence outcomes** to real, industry-relevant scenarios is inspiring; and, as is revealed by this report, prepares young people well for **Further or Higher Education** or for **direct career paths**.

This is curriculum innovation in action – **partners collaborating** to provide relevant and **challenging learning for young people** whilst also adding value for all involved. This study tells a compelling story and presents a sustainable way of meeting and developing our **Developing the Young Workforce (DYW)** and Curriculum for Excellence ambitions in Scotland."



"Scotland's adoption of the DEC Learning Programme with qualifications at SCQF Levels 4 and 6 has been inspiring to witness. From a standing start on 2015-16, now over 700 Scottish pupils are studying DEC programmes. **This shows the vision and ambition Scotland has for its young people.** We're delighted that Alex, Mark and Laura, alongside their pupils and students, have been able to complete this report to share their experience and assist others in making the most of our programme.

The Construction Industry desperately needs **a pipeline of skilled, engaged and articulate young talent**, enthused by the potential of our industry. Heriot Watt University, Drummond High School and Laing O'Rourke have been exemplary in their approach and this report demonstrates the **tangible benefits** of this unique partnership model. I applaud this report and all its contributors (especially the fantastic Drummond students!)."





Joan MacKay
Assistant Director,
Education Scotland



Alison Watson MBE
Chief Executive,
'Class of Your Own' Ltd

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Purpose of the Report

- To provide a **briefing resource for school teachers** providing the DEC Level 1 curriculum, making recommendations on
 - Resources required (physical and virtual)
 - Logistics
 - Expertise that can be accessed, suggesting means to access suitable partners
- To improve the profile and **understanding of built environment careers** amongst pupil support courses (careers advisors)
- To identify and recommend specific **opportunities for HEIs to support this delivery**, and relate these to HEI incentives, eg Industry engagement, impact, accreditation criteria and TEF targets.
- To identify and recommend specific **opportunities for local Industry partners** to support this delivery, and relate these to partner incentives, eg community engagement KPIs, CSR targets.

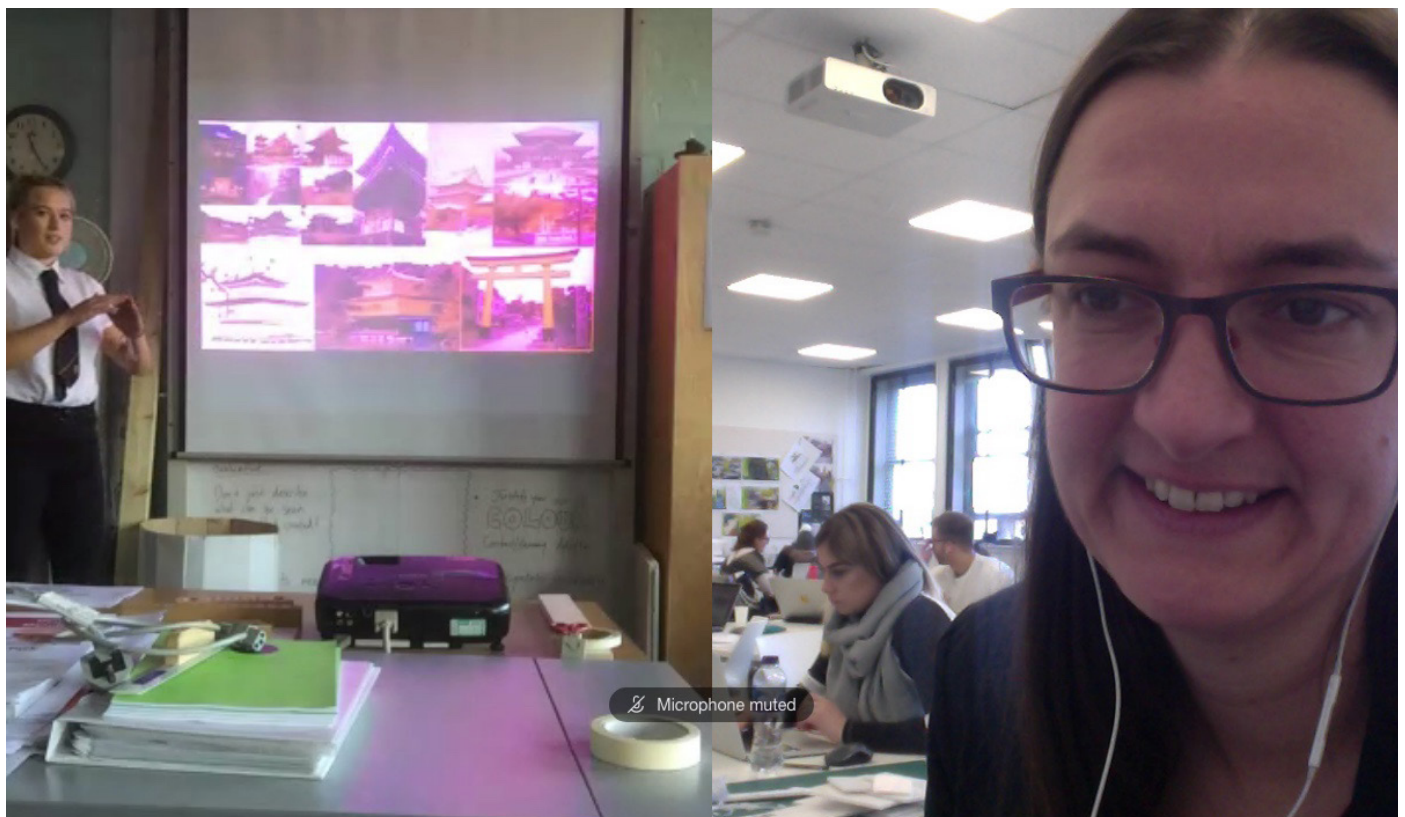
Scope of the Report

This progress report provides a review of the delivery of DEC curriculum materials at DCHS over the academic year 2016-17 (Level 1 DEC), and provides an overview of current engagement for the year 2017-18 (Level 2 DEC). The emphasis of the report is on evidencing value for all contributors to the DEC curriculum: pupils, teaching staff, schools, HE partners and Industry partners. The report is designed to provide a developmental resource to the DEC team, to future DEC teachers, and potential DEC partners from higher and further education, and industry.

DEC in the Scottish curriculum

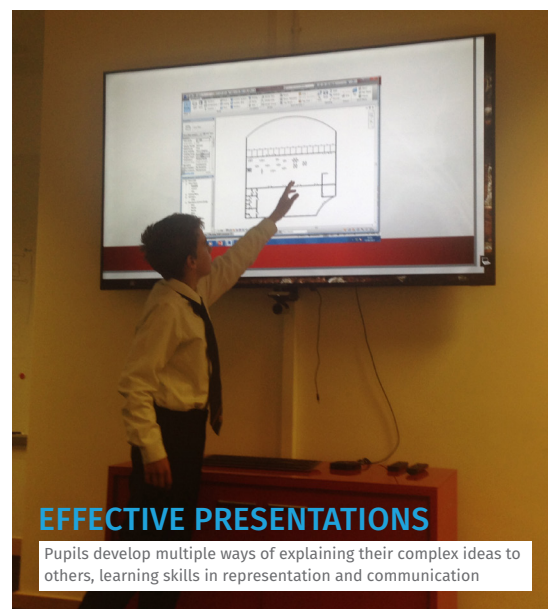
The DEC curriculum – even at level one - exemplifies “creative, practical and work based experiences”; key elements of the Curriculum for Excellence **technologies, experiences and outcomes**. It allows students to meet (and exceed) all of the craft, design, **engineering and graphics** outcomes at SCQF level 4 as well as those for **technological developments** in society and business, and addresses **digital literacy** outcomes. It demands a wide range of **literacy** outcomes, and, as a course with its roots firmly in the **mathematics** of the built environment, excels in **developing and applying** numeracy skills in a new, relevant context. Links are further made across Geography, Art & Design, Drama, Health and Wellbeing, all three sciences, Business and Computing.

EXAMPLES OF IN-PERSON AND REMOTE LEARNING, SHARED ON SOCIAL MEDIA





ACTIVITY EXAMPLES : PRESENTING AT THE DEVELOPER'S SITE OFFICE, JUNE 2017



Executive Summary

The DEC curriculum provides a project-based learning opportunity to teenagers via a curriculum deliverable in schools. DEC has been recognised at SCQF Level 4 (DEC Level1) and SCQF Level 6 (DEC Level 2) in Scotland. The DEC curriculum framework is designed to be supported by industry and/or academic parties, external to the school, who arrange with the provider to join classes periodically to engage with the pupils' learning.

This report highlights the value of this **engagement of industry and academia in school-level curriculum**. There is evidential, replicable, measurable value to all parties, indicating **a sustainable relationship** that will support ongoing collaboration **at no additional cost**.

Whilst based on a specific case study of three parties (Drummond Community High School [school]; Laing O'Rourke [industry]; and Heriot-Watt University [academic]), the project has been able to pilot studies of different methods of engagement, with the aim of providing relevance across the widest-possible spectrum of application. The project concludes by recommending specific strategies that might allow this **mutually-beneficial relationship** to be replicated in a wide variety of scenarios where DEC is taught.

Evidence in this Report

- The stages of L1 and L2 DEC are recorded chronologically with a **reflective narrative** intended to help teachers prepare for delivery.
- DEC pupils and their teacher provide **qualitative feedback** and evidence of the learning value of this engagement. Surveys reveal that **more pupils are considering construction as a career path**.
- Industry Partner provides feedback of personnel development and evidence of in-house and external marketing, sustainability and **CSR (corporate social responsibility) targets** and **KPIs (key performance indicators)** met through engagement with DEC.
- Academic Partner provides evidence of DEC engagement contributing to **staff development**; engagement and **outreach targets**; student experience and development; **professional accreditation criteria** and **graduate attributes**; and specific mapping against the TEF (**Teaching Excellence Framework**; measured against criteria TQ1, YQ3, LE2, S02 and S03)

“IT IS HOPED THAT THIS STRATEGY WILL INFORM A FRAMEWORK THAT CAN BE USED ACROSS THE UK TO SUPPORT DEC DELIVERY IN SCHOOLS IN A SUSTAINABLE, MUTUALLY-BENEFICIAL COLLABORATION BETWEEN HEI’s (AND/OR FE COLLEGES), INDUSTRY PARTNERS AND SCHOOLS/ACADEMIES.”



Strategies for Mutual Benefit

Each highlighted activity described in this report can be understood to benefit all parties engaged in that activity. If planned in this way, this pilot study indicates that:

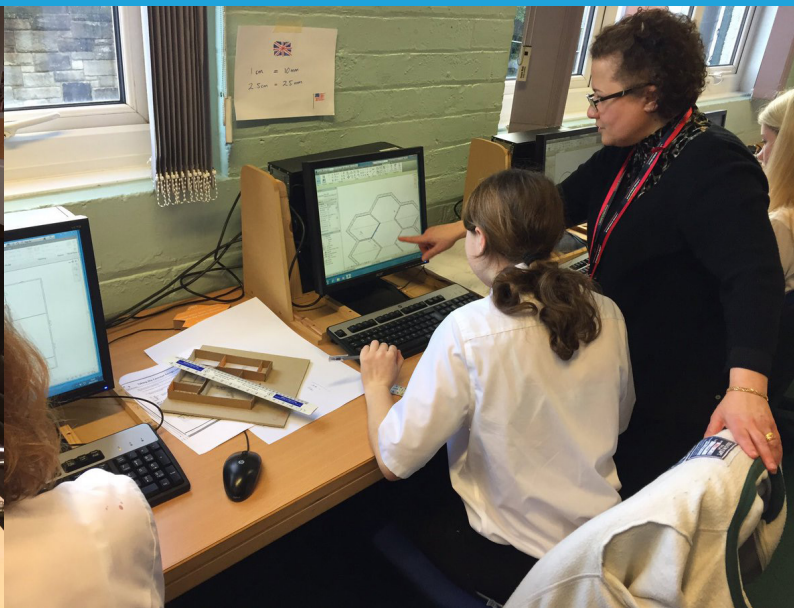
- **Industry Partners** are able to cite their engagement with delivering the DEC curriculum in order to **demonstrate meeting KPIs** relating to quality and accreditation standards, for example ISO 9001 and ISO 26000, community engagement, and company-wide CPD and skills training; and at project level, demonstrating **BREEAM and/or LEED criteria**
- **University Students** can provide effective support for DEC pupils in schools, and in doing so, **develop skills** essential to their own development. These include essential specific **professional skills**, and more general **Graduate Attributes**.
- In this way, **university staff** can clearly justify themselves and their students engaging with DEC delivery during **credit-bearing timetabled course time**.
- A degree of ‘**exploring the unknown**’ is fundamental to the DEC curriculum learning strategy, and teachers acting as a ‘guide on the side’ rather than a ‘sage on the stage’ is a productive classroom relationship for this course.
- Support from the above two groups is much appreciated by the pupils, and is of significant reassurance and **assistance to DEC teachers**, and can be **provided remotely** using digital tools and communication apps.

The project continues....

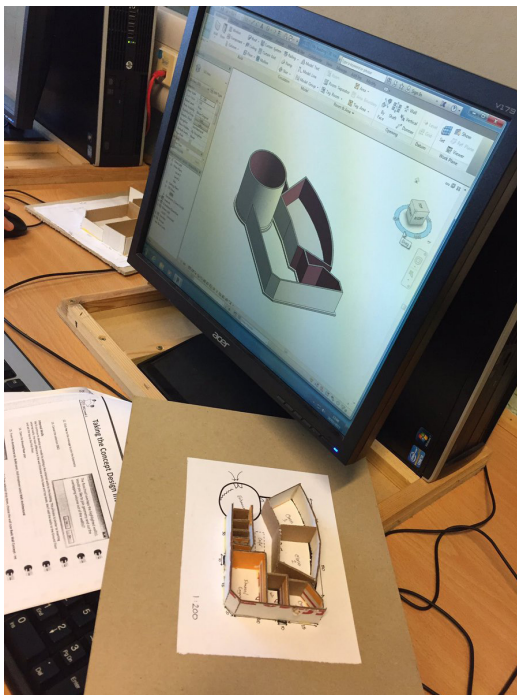
On the basis of the first stage of this project, funded by CITB and BIM4Education, additional resources have been secured for Heriot-Watt University to continue and develop this engagement in the coming academic year. Academic partners are currently engaged in curriculum redesign in order to better take advantage of the DEC provision **to mutual benefit**.

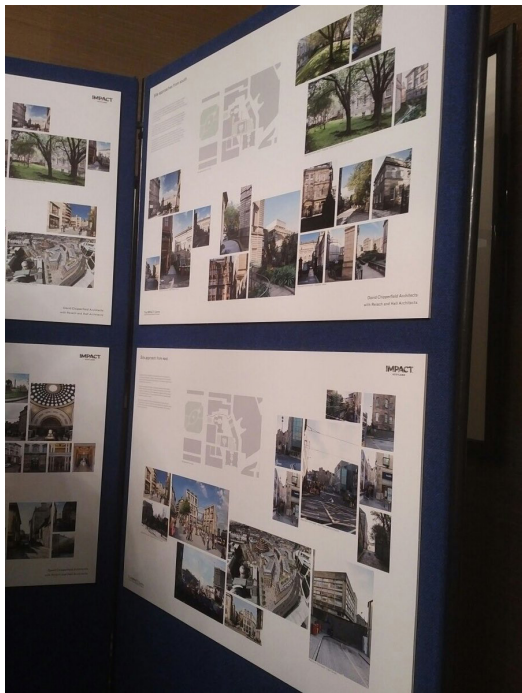
The second stage of this project, commencing in September 2018, will develop the integration of HEI support in the classroom for Level 2 DEC delivery, piloting the structured, **direct engagement of university students in supporting classroom delivery**. Student input will be mapped against curricular learning outcomes and accreditation criteria, enabling student classroom assistants to **directly receive credit for their engagement**.

The authors will also work with local Industry partners to develop a framework for effective engagement and **map this against Industry KPIs and incentives**.



this page from
Top left: viewing
site documents
with LoR;
working with
Revit experts in
the classroom;
DEC class till
going strong
after-hours;
both physical
(card) and digital
(computer)
models
TOP BORDER:
twitter shares
from the class
account





this page from Top left: presenting to industry visitors in class; visiting developers' offices; presenting at the CSIC (Construction Skills Innovation Scotland) event; commenting on planning proposals.

Delivering the DEC curriculum: Level 1

Delivering the DEC curriculum at DCHS

The DEC curriculum was delivered to a class of between 8 and 13 students, aged between 14-17 years old. The classroom is a DT (Design / Technology) classroom with central tables and perimeter computer workstations each equipped with CAD and internet access. The classroom also includes a laser-cutter and modelling materials.

The class followed the materials provided by the DEC curriculum online, including digital workbooks, links etc.



a teacher's perspective

“DEC level one is set out so that it can be easily taught for design and technology teachers who don’t [have specialist knowledge/skills], however level two is so much more in-depth, it goes beyond the basic knowledge that is provided so the professionals really do help.”

“The DEC class is the easiest class to get to do work as most of the students are interested and seem to understand what is required from them.”

Activities Undertaken

- Industry partner visiting school in class time to
 - make presentations
 - critique students' presentations
 - participate in a seminar
 - work on specific skills (CAD/surveying etc)

- Academic partner [staff member] visiting school in class time to
 - make presentations*
 - critique students' presentations*
 - participate in a seminar

- Academic partner [student member] visiting school in class time to
 - participate in a seminar
 - make presentations
 - critique students' presentations*
 - work on specific skills (CAD/surveying etc)

- Academic partner [student member] visiting school outside class time to work on specific skills (CAD/ surveying etc)
- Academic / Industry partners organising activities outside the school (site visit/ presentation)
- Pupil visit to academic institution to critique university students' work, as their "client"

*items marked with an asterisk were conducted both 'in person' and **remotely**, via live or recorded video link. This demonstrates the possibility of remote support and engagement where geographical location makes physical engagement difficult.

....a Timeframe for these activities is provided on the following pages

TEACHERS, PROFESSIONALS AND PARENTS VISIT THE DEC CLASSROOM AT DCHS
JUNE 2017



DEC Level 1 Curriculum :

DEC Level 1 Reflection (School)																
Week	Activity	Who	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Using the workbook, project outcomes															
2	Onenote, Mindmap considerations															
3	Sustainability. Produce questionnaire															
4	Presentation on survey results															
5	Site visit – client and community	Laing O'Rourke:														
		Sustainability, project management, QS, planning.														
6	Write up. Town planning. (propose uses for development of sites)															
7	Visit – Project team	Laing O'Rourke:														
		Sustainability, project management, QS, planning.														
8	Team leaflet															
9	Architect 1 Role, clients & brief	Architect														
10	Client moodboard and brief															
11	Architect – precedents and community needs	Architect														
12	Research – info boards															
13	Architect – concept modelling and sketching	Architect														
14	Concept modelling and sketching															
15	Modelling & sketching. Prep for presentation															
16	BIM – Revit training															
17	BIM – Revit training															
18	BIM modelling of solution															
19	BIM modelling of solution															
20	BIM modelling of solution															
21	BIM modelling of solution															
22	BIM modelling of solution	BIM ninjas (Laing O'Rourke)														
23	BIM modelling of solution	BIM ninjas (Laing O'Rourke)														
24	Building services engineer	Building services engineer														
25	Apply BS to classroom plan															
26	Landscape designer	Landscape designer														
27	Produce garden plan for eco classroom															
28	Site engineer visit; using maths on site.															
	Positioning and orientating a building. Setting out. Pythagoras.															
29	Write up site engineer visit															
30	Facilities manager (school based)															
31	Produce evidence chart on sustainability of existing school															
32	Planning – prepare structured debate on given planning scenario															
33	Debate carried out to panel															
34	Procurement – Using BIM, produce a chart of materials and state their impact on sustainability															
35	Procurement – visit – procurement / suppliers work with students to source materials / cost bill of quantities															
36	Presentations – prepare for presentations	Art, Reprographics														
37	Presentations – prepare for presentations	Drama														
38	Presentations – prepare for presentations															
39	Dry run – present to class	Drama														
40	Present to panel	Panel														

AN AID TO TEACHERS IN PLANNING THE CURRICULUM

ool Lead) - timetable only

[illegible]

School reflections on DEC Level 1

Week	Activity	Who	Equipment	Reflection
1	Using the workbook, project outcomes		Computer suite (PCs), pupil logins, Onenote class notebook	In future, have something useful for pupils to do while we sort out inevitable technical issues. They could probably read through / highlight the majority of section 1 on the workbook in this time – <i>have some printed hard copies?</i>
2	Onenote, Mindmap considerations		Computer suite	
3	Sustainability. Produce questionnaire			This needs some resources – online is fine- on producing good surveys / questionnaires. Should also include in this lesson tips on presenting as this is next week's task.
4	Presentation on survey results		Projection eqt.	Better to start early and leave time between than give lots of time to prep.
5	Site visit – client and community	Laing O'Rourke: Sustainability, project management, QS, planning.	EE2 forms, Risk Assessments	It's definitely worthwhile having a "whole-course-long" EE2 and RA completed to cover trips such as this. Share RA with provider beforehand. This trip has a positive impact on pupils. Seeing how relevant their work is to genuine practice, the varied opportunities, and the scale of this in the real world really gets them fired up, and provides lots of fodder later to hang concepts on.
6	Write up. Town planning. (propose uses for development of sites)		Computer access. Plans / pictures etc. of various sites.	Worthwhile here using sites that pupils are familiar with. Info on local areas – or links to would be useful.
7	Visit – Project team	Laing O'Rourke: Sustainability, project management, QS, planning.		Would be good to have a definitive list for this part. Worked well with what we had. However, Ideal 'dream team' * Design input. Architect, Interiors or Façade * City-scale input. Planners, or Urban Designers, or Policy-makers. * Engineering Input. Structural and/or Services or others. * Surveying Input. Quantity Surveyor, or Land surveyor * Contractor (Builder) input. Possibly project manager or site manager. All these groups of people think about building projects differently, so they all provide different things to say to the learners.
8	Team leaflet			Evidence production

DCHS TEACHER REFLECTIONS ON THE DEC LEVEL 1 DELIVERY

9	Architect 1: Role, clients & brief	Architect	Presentation eqt.	Good to start joining what they think they know to the real world. Architect taking concept of (eg) working with a client and telling how it actually went – particularly if involved with a project the pupils know.
10	Client 'moodboard' and brief		Either internet access and software or magazines/ scissors / glue etc.	Would actually work better with a client – working through images and selecting. <i>Perhaps- pupils can role-play each other's clients?</i>
11	Architect2: precedents and community needs	Architect	Presentation eqt.	Tricky one to get across. We got lucky with our partner, but worth hashing out beforehand, and this is one that will always be better 2 nd time around- its second nature to a working architect, but the pupils have never heard of it, so there's a big divide to bridge.
12	Research – info boards		Internet access & software to compile info boards	More direct access to relevant resource would have helped – a lot of flailing around on google here – although they're still developing a future relevant skill.
13	Architect – concept modelling and sketching	Architect	Liaise with architect – cut blocks – foam / timber. Boards. Boxes. Range of materials.	Brilliant. Ways of turning early concepts (bubble diagrams) into physical shapes. <i>Probably could've done bubble diagrams the previous week, and completed for homework.</i>
14	Concept modelling and sketching		Materials – modelling and sketching. Storage for models!	Really feels like you're getting into something now. Learners are beginning to ramp up their investment.
15	Modelling & sketching. Prep for presentation		Materials – modelling and sketching. Storage for models!	Recap, or add to resources regarding presenting.
16	BIM – Revit training		Whitefrog Revit book highly recommended. Obviously, computer suite, Autodesk Revit. Storage!!	Revit models are large and back themselves up periodically. All crashes / deletes so far have happened to pupils with limited storage. <i>You need more file storage space on your computers than you think. Think of a number, double it!</i>
17	BIM – Revit training			
18	BIM modelling of solution		DEC Academy and / or 3d made easy. Youtube access also extremely beneficial.	
19	BIM modelling of solution			
20	BIM modelling of solution			
21	BIM modelling of solution			

22	BIM modelling of solution	BIM ninjas (Laing O'Rourke)		Wow – having the Arch Tech / BIM guys in from Laing O'Rourke to troubleshoot and help out was just awesome. Flew through issues and gave really brilliant suggestions to pupils. Really helps to show / remind pupils that the software is an enabler rather than a barrier, they're just taking first steps.
23	BIM modelling of solution	BIM ninjas (Laing O'Rourke)		
24	Building Services Engineer	Building services engineer	Liaise with engineer	Can be dry. Probably worth looking at some activities beforehand & liaising with BSE.
25	Apply BS to classroom plan		'Disto's, Revit or scale eqt.	Surprisingly difficult to do in two hours
26	Landscape designing / Surveying	Landscape designer / Landscape Architect (LA)	Liaise with LA – buckets, hose, water. sticks / rules. Clipboards / ipads	Brilliant fun – but our landscape architect admitted they never used a water level! LA got pupils to draw cross section – great evidence.
27	Produce garden plan for eco classroom		Site map, tracing paper, colour pencils	Sadly, lots of pupils missing from this particular session. Limited impact
28	Site engineer visit; using maths on site. Positioning and orientating a building. Setting out. Pythagoras.		Site map. Rulers. Calculators (mobile phones)	After looking at the content, <i>we decided to do this one 'in-house', purely because we knew that it would take the pupils the full session to apply the maths in some cases, and professionals might get the pace wrong.</i> Worked really well – went through some set examples – simple shapes and dimensions, randomly drawing north south line on plain paper. Pupils that got it helped out the others, all had it by the end of the session. We used the section from the DEC maths book as consolidation which helped.
29	Write up site engineer visit			***weeks 29 to 35 were during exam leave***
30	Facilities manager (school based)			
31	Produce evidence chart on sustainability of existing school			
32	Planning – prepare structured debate on given planning scenario			These sections as a result were only covered by a few pupils who were in S3 or came in during exam leave. Pupils who wish to complete the course will have to catch these sections up next term in preparation for sitting the exam at one of the mid – year opportunities. To this end, we need to factor this into future timelines.
33	Debate carried out to panel			
34	Procurement – Using BIM	produce a chart of materials and state their impact on sustainability		
35	Procurement – visit	– procurement / suppliers work with pupils to source materials / cost bill of quantities		

DCHS TEACHER REFLECTIONS ON THE DEC LEVEL 1 DELIVERY

36	Presentations – prepare for presentations	Art, Reprographics	Mounting board, paper, glue, card, staplegun, spraymount, A3 colour printer, display boards, modelling materials – honestly, you name it – including 2 wooden palettes, some castors and a Christmas tree!	You literally cannot be prepared for this section – best you can do is be as well stocked as possible, and agile when you need to be. People who can (and are happy to!) run reprographics – often repeatedly, and people who can “nip out” and buy borrow or source materials are invaluable. You’ll find out here just how resourceful and independent the pupils have become – camcorders, plotters, voice-over friends, photo / BIM montages, and the laser cut palette on wheels all featured.
	<p>... and we didn't see any of it coming! Saying no to any idea here is just capping creativity, and we were loathe to do so, the pupils in return solved a lot of their own problems really effectively. Various staff around the school are really helpful as well – Art were particularly helpful, but there were materials appearing from FCT (used to be Home Economics) and PE, technical issues getting sorted by computing and Music departments, evidence coming from Geography, and of course Maths! On reflection, probably worth getting Art involved – and prepared - next time round, and can see strong links with Music (editing software) and IT in future – particularly at Level 2.</p>			
37	Presentations – prepare for presentations	Drama	Drama teachers are great here. Space and Equipment to run through presentations INCLUDING transporting presentations – digitally making sure they work on another platform etc.	Drama teacher involved in presenting is really useful. They're particularly good as they can totally disassociate the content from the delivery and focus resultantly. Don't underestimate the absolute certainty that technology is out to get you. Have at least 3 methods of saving and transporting digital presentations, and carry different formats. Carry ones with and without visualisations as this knocks some computers out.
38	Presentations – prepare for presentations			
39	Dry run – present to class	Drama	Pupils, staff and space booked for enough time to get through and feedback.	
40	Present to panel	Panel	Laura at LOR set this all up – panel members, client office for presentations etc. Check digital media, IT support and logistics if doing this off site.	This is really what makes the whole thing so special – the pupils were totally motivated towards this event, and having it off site with a panel of experts really added gravitas to the occasion. Highly recommended. You need to have this planned and in the school calendar early, as pupils will be off timetable in order to get it done. End of term's a great time to do it – easy to get pupils 'off timetable', and relatively easy for them to get extra work done beforehand if needed.

DEC Level 2 Curriculum :

[illegible]

[illegible]

Date: July. 2018

Conducted by
Alex MacLaren
& David Kelly

Academic Reflection

Universities and Colleges have an interest in engaging with young people, in order to make them aware of future opportunities for study. In addition, we are required to demonstrate engagement with local schools and colleges, and the local community. Finally, as part of a rounded education, we wish to teach our current students skills in communication, mentoring, and professional behaviours. **Engaging with DEC allows us to enhance all of these activities.**

At a Strategic University Level

- DEC engagement hits academic requirements for **outreach**. If linked into current university teaching or research projects (for example, in the precedent or task-specific sessions) this can contribute to TEF and REF submissions. These are important targets for universities in league-tables and in securing funding.
- DEC also evidences direct engagement with the '**applicant pipeline**' for local school pupils wishing to study construction industry subjects. This improves our **staff awareness** of local community perceptions and interests.
- This activity aligns with national construction industry and UK government targets for **encouraging STEM careers** and plugging the 'Skills Gap' (See *UK STEM Education Landscape* (2016) and *Delivering STEM skills for the economy* (2018))
- **Invests in our future** students: upskills our potential applicants, particularly in familiarity with industry softwares and tools, prior to arrival at university

an academic's perspective

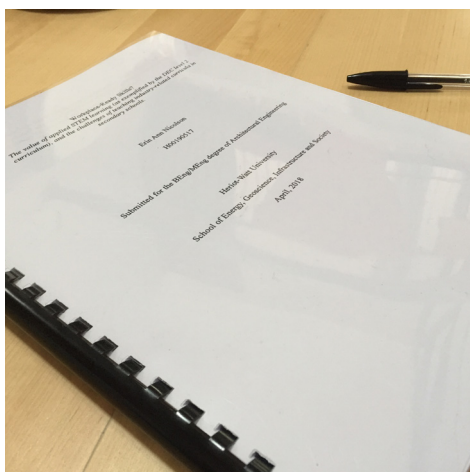
“Promoting and Developing STEM skills and construction careers is so important for our future industry, and our students develop this awareness and ability as they work with the pupils on their designs.”

“Our university students learned a lot about communication skills from being asked to present to the visiting DEC class. I can map this experience directly against Learning Outcomes for their accredited degree.”

In this academic year our 'pilot' study regularly engaged two final-year students (of Architectural Engineering and Construction Project Management) directly with the DEC Level 2 class in a longitudinal study. These students were authoring dissertation theses around accessing STEM careers in construction, and were able to connect their DEC experience directly with their research. This contributed directly to their graduation with Bachelors and Masters degrees in 2018 (below).

In addition, further students had opportunities for engagement, for example presenting their own group projects to the DEC class when they visited the university, or contributing as a remote panel member in pupil presentations, enabled by VC software (see page 7).

In the academic year 2018-19 we are proposing more regular engagement of a wider spectrum of students in accordance with the opportunities noted in the following section. All engagement will be mapped against academic curriculum criteria.





HERIOT-WATT UNIVERSITY

Architectural Engineering

www.hw.ac.uk/ug-archeng

Architectural Engineering Entry Requirements

Our Architectural Engineering courses are delivered by the School of Energy, Geoscience, Infrastructure and Society (EGIS) which offers both undergraduate and postgraduate courses in areas critical to economic development and societal equity. www.hw.ac.uk/egis

Architectural Engineering BEng (Hons)	
Architectural Engineering MEng	
Architectural Engineering with International Studies MEng	

Entry Requirements

Required subjects are shown in brackets

Year 1 entry

- Highers: AAAB or BBBBC (Maths B)
- A-Levels: ABC or BBB (Maths B)
- Int. Baccalaureate: 31 points (Maths HL5)
- Scottish Baccalaureate: Pass (Maths Advanced Higher)

*Subjects such as Physics, Design-Engineer-Construct (DEC), Design and Technology are desirable but not an essential entry requirement

Year 2 entry

- A-Levels: ABB (Maths)

Additional information

For all years, applications are welcomed from holders of non-school qualifications and mature candidates. All EU and overseas candidates will require an IELTS overall grade 6.0 (or equivalent with no component 5.5 or below).

Why A at Her

- Gain the knowl...
- Understand th...
- Recognise th...

Course hig

In year 1:

In Year 2:

In year 3:

Academic Summary

Current Students engaging with pupils through DEC has multiple benefits:

- Teaches interpersonal and social skills that develop our university '**graduate attributes**': key targets against which we must plan our curriculum
- Experience of preparing classes, presentations, and mentoring pupils also teaches skills that can be **directly aligned to Learning Outcomes**, and so included in curricula
- These same behaviour map strongly against **professional accreditation** criteria (ICE, CIOB, RICS, RIBA).
- This opportunity expands our scope for providing a **variety of learning experiences**: Off-site and project-based activity with school pupils is attractive to a student demographic traditionally disengaged by 'dry' lectures.
- The student experience can also be mapped against multiple TEF criteria (TQ1, YQ3, LE2, S02 and S03)



STUDENT ENGAGEMENT WITH THE DEC PUPILS FULFILS SEVERAL OF THE UNIVERSITY'S AMBITIONS FOR 'GRADUATE ATTRIBUTES', AND CONTRIBUTES DIRECTLY TO PRACTICES RECOGNISED BY THE 'TEF' (TEACHING EXCELLENCE FRAMEWORK)



Date: March. 2018

Laura Stone,
interviewed by Erin
Nicolson

Industry Reflection

Laing O'Rourke chose to sponsor and support the DEC curriculum at our Edinburgh St James Project, with Drummond Community High School. Laing O'Rourke are the main contractor on this project for developer, TH Real Estate.

This is part of the Project Team's commitment to Curriculum Engagement, Employability and Training, which includes

- Over 1,300 people inducted on site, 1,000 of whom (79%) live within 100 miles of the project
- Over 200 days work experience provided (from a combination of schools, universities, graduates and those not in education or training)
- Over 260 students from 27 different schools, colleges and universities engaged through the project's curriculum engagement activities and work experience opportunities (including engineering, sustainability, digital engineering and construction activities)
- 10 Design Engineer Construct lessons supported at Drummond Community High School by members of the development team, from architects to digital engineers and landscape architects to building services engineers



Images: TH Real Estate and Laing O'Rourke

an industry perspective

“we have an extensive set of community benefit targets..... It is important that the project engages in meaningful curriculum engagement activities in the local community [DEC].”

“it is important to put the learning into context. For this reason, we [invite] the students for a site visit on a couple of occasions to show real site progress. A couple of the students also chose to spend their week’s work experience with Laing O’Rourke.”

Mapping Activities (a)

Activity	Skills	Potential Careers (examples, not comprehensive!)	Notes
Using the workbook, related research	Autonomous learning, self-directed research. Search techniques and editing skills	Generally applicable research skills	Improved autonomy = greater preparedness for the world of work or Higher Education
OneNote, mindmaps	Record and Synthesise information using a variety of media / softwares	General workplace-ready skills	Use of a variety of softwares, improved techniques of self-learning and recording information
Class presentations / group seminars	Self-confidence and Peer-group support. Experience of presenting own work. Skills in working with others	Teaching, Public Service, Customer-facing roles. Teamworking and interpersonal skills are essential to most careers.	
External presentations	Public speaking skills. Communication skills	Any/all client-facing professional roles	Better to start early and leave time between than give lots of time to prep.
Conducting a survey/ questionnaire	Designing an experiment. Managing data. Presenting qualitative and quantitative data.	Generally applicable research skills, marketing, auditing, policy, civil service	
Site visits	Observational skills. Practical application of theory. Understanding of Construction Industry. Site Management / Logistics skills	Project management roles across Sectors. Site-based roles (physical and management). Logistics management.	
Client brief development	Synthesis of Information. Community engagement techniques. Design development. Logistical thinking	Client Agent, Civil service and professional roles	
Precedent research	Research skills, representation skills. General knowledge in history/arts/economics related to scheme	Skills relevant to research and archive roles. Knowledge relevant to a variety of careers.	The breadth of the scope available allows students to select particular areas or characteristics of personal interest

Skills and Careers

Activity	Skills	Potential Careers (examples, not comprehensive!)	Notes
Concept modelling and sketching	Motor skills, practical crafts experience, maths, art and design, communications, problem-solving	Art and Design, Crafts, Product Design, Architecture, Animation	Arts- and/or Engineering-based design roles
CAD modelling and scheme development	Computer skills, design, iteration, problem-solving	Art and Design, Crafts, Product Design, Architecture, Animation, CAD technician	
Selection of Materials	Research, evaluation, finance, cost and energy awareness, knowledge of physical properties of materials	Specifier (many industries), Quantity Surveying, Physics, Materials Science	Skills relevant to an extremely broad range of professions
Building Services Design	Basic physics, design, problem solving, research	Architectural Engineering, Building Services Engineer or Technician, or manufacturer/Installer	
Landscape Surveying and Design	Observation skills, mapping, maths, design, geography and natural biology	Landscape Architect, Land Surveyor, Real Estate, Physical Geographer	
'Setting out' on site	Maths, practical skills, teamwork and people management	Site management, Surveying, Project Management, logistics	
Planning Debate	Geography, politics, advocacy, research, public speaking, role-play, evaluation, presentation	Planner, Urban Design, Councillor, Lawyer, Real Estate, Developer, Human Geographer	
Procurement planning	Financial appraisal, maths, logistics, teamwork, people management, evaluation	Quantity Surveying, Finance, Contracts Management, Law,	
Final Presentations (external)	Public speaking, communications skills, synthesis and evaluation	Any/all client-facing professional roles	Presenting to unknown audiences in unfamiliar situations, but with peer support, develops significant confidence beyond the classroom

Mapping Activities (b)

There is potential for external engagement at many stages of the DEC curriculum. A selection of suggestions are recorded here: it would be extremely unlikely to enable every session: instead this gives an idea of the flexibility of engagement opportunities across the curriculum. Engagement is flexible: more input in one area over another is not detrimental to pupil experience!

Activity	When (how)	Who	Notes
* this process specifically maps engagement opportunities referencing the Level 1 delivery timeline, but many activities/opportunities are directly applicable to Level 2 delivery			
Sustainability Questionnaire	Week 3	both Student / academic partners	A 'soft' remote introduction is possible here, if questionnaires are distributed remotely (eg online). This starts the conversation.
Site Visit	Week 5	Industry Team	Ideally the industry partner can show pupils a real construction site: but any visit to a real development site, with an industry team, will show pupils how industry professionals look at and analyse a site. This could be a potential site rather than one already underway; care is needed to consider student numbers and activities whilst on site.
Visit from Project Team	Week 7 <i>(could be run remotely with skype tour of offices / uni & Q&A but personal visit best)</i>	Industry Team	Industry partners (and/or academic partners) meeting pupils on their 'home turf'- eg coming in to the classroom. This is a very different experience for both parties. Direct learning in public engagement and communications for industry partners and/or students. The Industry attendees for this part could be graduates or more senior positions: both will learn from the experience, and pupils & teacher will gain the required input from either.
Architect (of a project known to the class)	Week 9	Industry (Architect)	Industry professionals will generally be inclined to present for too long and with too much jargon, OR to 'dumb-down' too much. Allow for significant Q&A from teacher and pupils, as this is more engaging.
Precedent Studies	Week 11 <i>(could be run remotely, pre-recorded 'shorts' for discussion)</i>	Student Team or Industry Team member(s)	The concept of finding and analysing buildings as precedents is complex for pupils to grasp: ut this is a great chance to enthuse pupils about existing or proposed building projects and discuss some aspirational ideas, just before they get into concept development. A useful stage for students to get involved as it requires critical reflection from them on their own inspirations: clear learning on both sides.
Concept Modelling	Week 13	Industry (Architect) and/or students	Some student or industry input here is really valuable to get the line right between exotic spatial ambition and logic / buildability. Pupils can be encouraged to use anything to model and/or to also photograph their models in order to study them, eg 'from eye height'. Iteration (making several versions) is a useful skill to start here.

Opportunities for Engagement

Activity	When (circa)	Who	Notes
* this process specifically maps engagement opportunities referencing the Level 1 delivery timeline, but many activities/opportunities are directly applicable to Level 2 delivery			
BIM training and CAD Scheme Development	Weeks 16-23 <i>(some remote Q&A is possible, but this runs better in-person)</i>	Students or Industry	BIM needs to be seen as a tool. The most valuable input is probably after a couple of sessions, once the pupils have begun to understand and navigate the software. Student input here can be extremely valuable as there may be numbers enough to provide 1-to-1 or small-group support; and mapping the students' experience against professional and/or learning criteria is very simple in this stage: they are learning to mentor and teach others in a specific skill. This is also a stage where students who are excelling can be encouraged to revisit and develop their designs, improving on the original concept. This is also valuable learning. A variety of voices helps here. Revit can be frustrating: external assistance should remember the models do not have to be perfect!
Building Services Engineering	Week 24	Students or Industry	These sessions are important as careers awareness development. The level of detail need not be huge but an insight into the career, or FE / HE study, is really valuable. Industry/ Students need to be reminded to relate this to the pupils' design decisions
Landscape Surveying	Week 26	Students or Industry	
Setting Out	Week 28	Students or Industry	
Facilities Management	Week 30	Ideally 'in-house'- a school estates manager? perhaps alongside students or industry	This works well as a Q&A both ways: asking the students direct questions about how their schemes would be managed "where is this stored? how is this locked up? how is this maintained?" as well as from pupils to the facilities manager "what do you need for this? how big is this?" A tour of the school from an estates management point of view is also very helpful
Planning Debate	Week 32	Students	A great opportunity for role-play. We see an opportunity for students to organise this event, but have not yet been able to pilot this
Specification and Costings	Week 34	Students or Industry	Another career awareness session. It is interesting how motivating pupils find costing and money: they are really interested in big numbers and how you test feasibility, and making choices.
Final Presentations	Week 40	Everyone. Industry 'friends', local councillors/ educators, students.	An important celebration of all the pupils' work. Students could 'mentor' pupils towards this, as an alternative to making the presentation panel(s) too big.

the pupils' perspective

“I had never thought about working in the built environment until ... I began DEC level 1. Before this, I was more interested in a career in medicine as a doctor. DEC allowed me to explore the environment in a more creative way and as I consider art and design my hobby, it allowed me to apply these skills to explore a different world”

ALIZAH, S6

“[In level 2] there is a lot more research, which is challenging, and I also believe I am learning more”

COMMENTS FROM SURVEYS AND INTERVIEWS BY MARK HOLDEN AND ERIN NICOLSON

the pupils' perspective

"I really enjoy the professionals coming in."

"there is freedom, not one correct answer."

"there's a big focus on the industry in the course, and other subjects, like maths, engineering and geography."

" I learned that there is more to it than just designing a building and constructing it. The construction industry offers a wider variety of jobs than any other industry"

MUAAZ, S4

Summer 2018



Conclusions

This report collects evidence from the first year of a planned two-year engagement between HE, Industry and a local primary school in delivering the DEC curriculum. The findings of this report have provided the foundation for extended engagement in the forthcoming academic year: but it is also hoped that sharing the experience in this report may assist others around the UK in planning similar activities.

The premise of the project was to collect evidence demonstrating that the DEC curriculum could be delivered by cross-sector partners **to Mutual Benefit**. This has been clearly established.

Industry Partners are able to cite their engagement with delivering the DEC curriculum in order to **demonstrate meeting KPIs** relating to quality and accreditation standards, for example ISO 9001 and ISO 26000, community engagement, and company-wide CPD and skills training; and at project level, demonstrating **BREEAM and/or LEED criteria**.

University Students can provide effective support for DEC pupils in schools, and in doing so, **develop skills** essential to their own development. These include essential specific **professional skills**, and more general **Graduate Attributes**.

In this way, **university staff** can clearly justify themselves and their students engaging with DEC delivery during **credit-bearing timetabled course time**.

A degree of '**exploring the unknown**' is fundamental to the DEC curriculum learning strategy, and teachers acting as a 'guide on the side' rather than a 'sage on the stage' is a productive classroom relationship for this course.

Support from the above two groups is much appreciated by the pupils, and is of significant reassurance and **assistance to DEC teachers**. There is significant scope for this to be **provided remotely** using communication apps and digital tools.

Things we wish we'd known

There are no stupid questions.

Just visiting a place of work, or site, is a really valuable part of the DEC curriculum.

Remote (on-screen) connection to offices or the university can still be valuable and increases pupil's confidence and familiarity with communications media.

Repeat visits to a developing project really engaged the pupils.

Asking students to work on/with local sites and developments, positively changes their day-to-day engagement with their local environment.

Visitors to the classroom ask questions that could never be predicted: and pupils learn from this and grow in confidence.

Shared experiences are valuable for both pupils and visitors.

**design...
engineer...
construct!®**

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CREDITS

THANKS TO

Erin Nicolson and Mark Holden, who conducted two interviews/ surveys of the DEC cohort pupils at agreed points throughout the year.

Alison Watson, Carole Teacher and Alma Mason, of **Class of your Own**, who contributed data to this report.

The Year 4 undergraduate students of Heriot-Watt School of Energy, Geoscience, Infrastructure and Society, who took the arrival of school pupils into their university assessment panels in their stride.

ADDITIONAL REFERENCES

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THE SUNDAY TIMES

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Mutual Benefit:

Investigating how DEC delivery in schools can be supported by industry and higher/further education partners

Alison Watson, a former Land Surveyor, established social business Class Of Your Own (COYO) in 2009. Her ambition was to transform Built Environment education, raising awareness of the breadth of careers that young people could access in Architecture, Engineering and Construction (AEC).

With a mission to develop innovative, contextualised approaches to teaching and learning, Alison created 'Design Engineer Construct!' (DEC), an accredited learning programme to be taught within the UK secondary school curriculum.

classofyourown®

Her commitment to facilitate genuine, sustainable relationships between education and industry was developed through the innovative 'Adopt A School' scheme. Leading, globally recognised organisations now support school teachers to deliver DEC throughout England and Scotland, reaping rewards for young people as firms look to DEC schools to provide their talent pipeline.